# Edwin Ernest Salpeter

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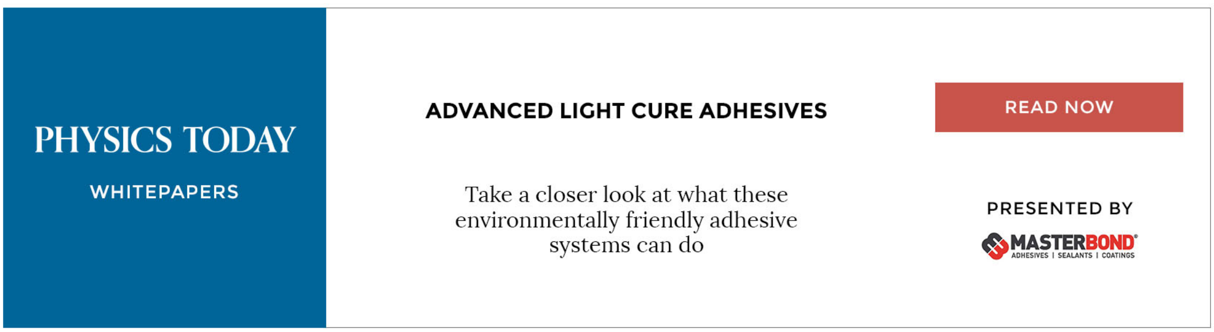

# obituaries

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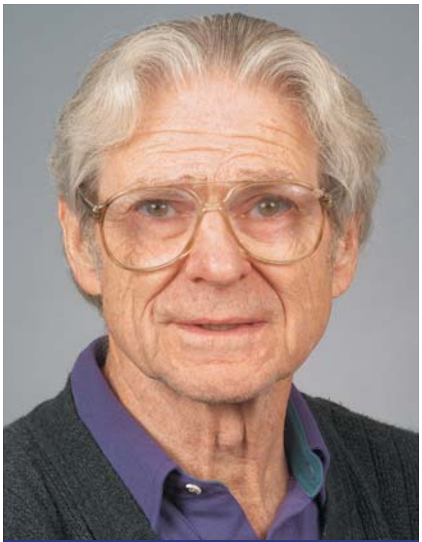
## Edwin Ernest Salpeter



**Edwin Ernest Salpeter**

Edwin Ernest Salpeter, among the most influential, prescient, and innovative astrophysicists of the past half century, died of leukemia at his home in Ithaca, New York, on 26 November 2008.

Ed was born in Vienna on 3 December 1924. He and his family emigrated to Australia in 1938 following the Nazi takeover of Austria. After he earned a BSc in 1944 and an MSc in 1945, both from the University of Sydney, a prestigious scholarship allowed him to become a doctoral student of Rudolf Peierls at the University of Birmingham in the UK; he received his PhD in quantum electrodynamics in 1948. Peierls and his old friend Hans Bethe often sent outstanding students to each other to get postdoctoral experience, so in 1949 Ed went to Cornell University, where he stayed for almost 60 years.

With the publication in 1951 of the Bethe–Salpeter equation, which governs two-particle bound states in quantum field theory, "Salpeter" became well known in theoretical physics. For most scientists, such early success would set the trajectory of their careers. Not Ed. He soon decided that his talents and temperament were not well suited to quantum electrodynamics but rather to some field, as he put it, "more controversial, more open-ended and new." Thanks to his interactions with Bethe, he came to realize that nuclear astrophysics was what he had been looking for.

For a while Ed pursued two paths: as an authority on high-precision atomic spectroscopy, including as coauthor with Bethe of a classic monograph, and as an innovator in the "open-ended" field of astrophysics.

His first astrophysics paper, published in 1952, solved the great puzzle of what fueled red giants, stars that have completed their burning of hydrogen into helium. It was known that no stable nuclei would, via a sequence of two-body reactions, lead from helium to carbon, and the probability of a direct three-alpha encounter was far too low. Using new data from William Fowler's group at Caltech, where he had become a regular visitor, Ed realized that beryllium-8, formed by fusion of two alphas, was metastable and would persist in sufficient quantity to lead to carbon-12 by fusion with a third alpha. Fred Hoyle then predicted that a resonance in $^{12}$C greatly enhances the probability of that final step. That work led the Royal Swedish Academy of Sciences to award the Crafoord Prize to Hoyle and Salpeter in 1997.

Among Ed's many other critical contributions to astrophysics was his "initial mass function," a simple power law that describes the number of stars of a given mass born from interstellar gas. That concept has played a key role in numerous scientific areas; an international conference celebrated the function's 50th "birthday" in 2005.

While Ed was proudest of his 1955 paper on the initial mass function, during his remarkably productive and versatile career he had many other pathbreaking accomplishments. He showed how electron screening affects thermonuclear reaction rates and the equation of state of dense matter. Starting in the 1960s, he turned from stars to ever-larger-scale phenomena: the physical chemistry of interstellar gas, galaxy rotational velocities and dark matter, and the development of galaxy clusters and superclusters.

Ed paid close attention to phenomenology and often predicted new phenomena. The most famous such prediction, also made independently by Yakov Zel'dovich, was that black holes could be revealed by the radiation emitted by accreting gas; that knowledge has become a standard way of identifying black holes.

The range of Ed's contributions to astrophysics was due to his mastery of a broad array of physics concepts and to his intuitive ability to identify the critical variables in any problem and to see scaling relations among them. Once he had that arsenal in hand, the rest was, to him, just details.

Ed's influence on astrophysics went well beyond his discoveries and publications. He trained many gifted graduate students and postdocs who hold positions in leading institutions across the globe.

Ed's reach extended beyond the physical sciences. His wife Miriam was a professor of neurobiology at Cornell University, and in his later years Ed contributed mathematical models to her research on the interaction of nerves and muscle fibers. After she died in 2000, he ran her laboratory for a time, then became a partner with his daughter Shelley, a physician at Stanford University, in the statistical study of clinical trials; they were later joined by his grandson Nicholas Buckley.

After his participation in 1987 in the American Physical Society's study of directed energy missile defense technologies, Ed became an outspoken critic of the Strategic Defense Initiative. Recently, with his second wife, Antonia Shouse, he fervently opposed the Bush administration's use of torture.

At age 24, Ed had gone to Cornell, where Bethe had assembled one of the world's greatest physics departments, with young members who would become famous in popular culture. Within a few years, Ed demonstrated comparable intellectual powers. But he was a modest man who did not display his depth and brilliance at first meeting. His amazing productivity always seemed incompatible with his relaxed demeanor, his role as the engaged father of a large extended family, his friendships worldwide, and his endless zest for travel, grand opera, and skiing. We count ourselves among the many who had the good fortune to be touched by the truly remarkable life of Ed Salpeter.

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